DEFENSE INFORMATION SYSTEMS AGENCY
JOINT INTEROPERABILITY TEST COMMAND
2001 BRAINARD ROAD
FORT HUACHUCA, ARIZONA 85613-7051

IN REPLY
REFER TO Networks, Transmission and
Integration Division (JTE)

14 Nov 03

MEMORANDUM FOR DISTRIBUTION

SUBJECT: MIL-STD-188-181B Conformance Certification of the AN/PSC-5C Shadowfire Manpack Radio (Certification 349.258)

References:

(a) DOD Directive 4630.5, "Interoperability and Supportability of Information Technology (IT) and National Security Systems (NSS)," 11 Jan 2002

(b) CJCSI 6212.01B, "Interoperability and Supportability of National Security Systems, and Information Technology Systems," 8 May 2000

1. References (a) and (b) establish the Defense Information Systems Agency (DISA), Joint Interoperability Test Command (JITC), as the responsible organization for interoperability test certification. Additional references are provided in enclosure 1.

2. Military standard (MIL-STD)-188-181B conformance testing has been completed for the AN/PSC-5C Shadowfire Manpack Radio. The terminal is certified as meeting the applicable requirements of MIL-STD-188-181B (reference (c)) to the extent detailed in the Conformance Certification Testing Summary (enclosure 2). The tested terminal components and associated software versions were:

AN/PSC-5C Shadowfire	RT-1672C(C)/U
Control Processor Software (CP-SW)	CTRL 02.78
Control Processor Hardware (CP-VHDL)	CPHW 02.10
Modem Orderwire Encryption Board (Modem OEB)	MOEB 02.00
Modem Digital Signal Processor (Modem DSP)	MDSP 05.19
Modem	Version 14.00
Shadowfire Baseband Processor Software (BP-SFIRE)	BPSW 08.13
SINCGARS Baseband Processor Software (BP-SGARS)	BPSW 08.13
Baseband Processor Hardware (BP-VHDL)	BPHW 02.40

Baseband Processor Hardware (BP-HW) ..... *BPHW xx.xx
Fill Processor Software (FP-SW)..... FPSW 05.05
Fill Processor Hardware (FP-VHDL) ..... FPHW 02.40
ANDVT Processor Software (AP-SW)..... APSW 08.19
ANDVT Processor Hardware (AP-VHDL) ..... APHW 06.90
ANDVT Processor Hardware (AP-HW)..... *APHW xx.xx
TCP/IP Processor Software (TP-SW)..... TPSW 06.07

* - Raytheon hardware manufacturing uses these version numbers to track revisions on manufacturing parts lists. These version numbers will vary in fielded radios and have no effect on the installed software.

3. Testing was conducted at the JITC Ultra High Frequency (UHF) Satellite Communications (SATCOM) test facility using the JITC procedures contained in "MIL-STD-188-181/MIL-STD-188-181A/MIL-STD-188-181B Terminal Test Procedure," May 2001. A summary of the test results is provided in enclosure 2.

4. Although the system is being certified compliant to MIL-STD-188-181B, an operational problem can exist if the transmit power is too high. The operator must ensure the transmit Effective Isotropically Radiated Power (EIRP) level does not exceed the levels listed in table 1 when operating in narrowband mode, including cable loss and antenna gain.

Table 1. Narrowband EIRP

INPUT/OUTPUT DATA RATE (bps)	MODULATION TYPE	CODING TYPE	MAXIMUM EIRP (dBWi)
1200	SBPSK	None	21.8
2400	SBPSK	None	18.9
4800	CPM	None	20.4
*7200	CPM	None	22.0
*8000	CPM	None	22.2
9600	CPM	None	20.1

*Optional Data Rate
bps = bits per second
CPM = Continuous Phase Modulation
dBWi = decibels referenced to 1 watt, relative to isotropically radiated power
SBPSK = Shaped Binary Phase-Shift Keying

5. When operating in wideband mode, the operator must ensure the EIRP level does not exceed the levels listed in the table 2, including cable loss and antenna gain.

Table 2. Wideband EIRP

INPUT/OUTPUT DATA RATE (bps)	MODULATION TYPE	CODING TYPE	MAXIMUM EIRP (dBWi)
*9600	SBPSK	None	19.3
19200	CPM	None	33.2
*28800	CPM	None	34.0
32000	CPM	None	32.9
38400	CPM	None	31.0
48000	CPM	None	29.3

*Optional Data Rate
bps = bits per second
CPM = Continuous Phase Modulation
dBWi = decibels referenced to 1 watt, relative to isotropically radiated power
SBPSK = Shaped Binary Phase-Shift Keying

6. Higher transmit EIRP levels will result in out-of-band emissions that exceed the limits set by the MIL-STD, and may cause friendly jamming in adjacent channels.

7. In accordance with reference (d), users are required to have terminals certified compliant to MIL-STD-188-181, -182, and –183. Engineering Change Proposal (ECP) 32 is a hardware and software modification to the AN/PSC-5 Spitfire Manpack Radio designed to provide a field upgrade resulting in the AN/PSC-5C Shadowfire Manpack Radio. ECP 32 uses a module replacement that provides additional data rates for MIL-STD-188-181B and Mixed Excitation Linear Prediction techniques. In addition, the upgrade includes improved narrowband voice vocoder, embedded Automatic Data Controller, embedded Internet Protocol layer, and numerous other enhancements. The additional enhancements include HAVE QUICK and SINCGARS frequency hopping, the addition of higher data rates in Line-of-Sight mode, and operator menu enhancements. This certification memorandum declares that the MIL-STD-188-181B portion of the overall Joint Chiefs of Staff-mandated requirement has been met for the AN/PSC-5C Shadowfire Manpack Radio.

8. Previous testing has demonstrated that even though a product conforms to standards, there is still a potential for incompatibility between UHF terminals that implement technical requirements differently. Therefore, prior to an initial operational capability assessment, terminal users must define the specific terminal operational requirements. Additionally, the terminals must be tested and certified for interoperability by JITC in accordance with reference (b).

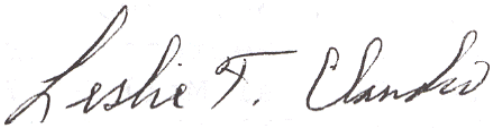
9. JITC distributes test documentation via the JITC Electronic Report Distribution (ERD) system which uses unclassified (NIPRNET) e-mail. More comprehensive information is available via the JITC System Tracking Program (STP). The STP is accessible by .mil/.gov users on the NIPRNET at https://stp.fhu.disa.mil. Test reports, lessons learned, and related testing documents

JITC Memo, Networks, Transmission and Integration Division (JTE), MIL-STD-188-181B Conformance Certification of the AN/PRC-5C Shadowfire Manpack Radio (Certification 349.258)

and references are on the JITC Joint Interoperability Tool (JIT) at http://jit.fhu.disa.mil (NIPRNET) or http://199.208.204.125 (SIPRNET). JITC also provides a DAMA Certification Register on the JITC public website under "Product Registers." The DAMA Certification Register can be reached directly at http://jitc.fhu.disa.mil/reg/dama1.html. The UHF SATCOM DAMA Test Facility homepage can be reached directly at http://jitc.fhu.disa.mil/reg/uhfdama.htm.

10. The testing agent point of contact is Norma Vega, DSN 879-1741, Commercial (520) 538-1741, e-mail vegan@fhu.disa.mil.

Sincerely,



LESLIE F. CLAUDIO
Chief
Networks, Transmission and
Integration Division

2 Enclosures:
1 Additional References
2 Conformance Certification Testing Summary

Distribution:
Joint Chiefs of Staff, Director for Command, Control, Communications and Computer Systems (J6), Room 1E833, The Pentagon, Washington, DC 20318-6000
Joint Chiefs of Staff (J6S), ATTN: CDR Brooks, Room IC832, The Pentagon, Washington, DC 20318-6000
Office of the Secretary of Defense, Director Operational Test and Evaluation, Room 3E318, The Pentagon, Washington, DC 20301-1700
Assistant Secretary of Defense (Command, Control, Communications, and Intelligence), ATTN: C3I, The Pentagon, Washington, DC 20301-8000
Defense Information Systems Agency (IN42), ATTN: Andy Pappas, 5600 Columbia Pike, Falls Church, VA 22041-2717
Program Manager's Office, Tactical Radio Communications Systems, Building 456, Fort Monmouth, NJ 07703-5000

ADDITIONAL REFERENCES

(c) MIL-STD-188-181B, "Interoperability Standard for Single-Access 5-kHz and 25-kHz UHF Satellite Communications Channels," 16 October 2001

(d) Chairman of the Joint Chiefs of Staff Instruction (CJCSI) 6251.01A, "Ultrahigh Frequency Satellite Communications Demand Assigned Multiple Access Requirements," 21 April 2003

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CONFORMANCE CERTIFICATION TESTING SUMMARY
(Certification 349.258)

1. CERTIFICATION TITLE. MIL-STD-188-181B Conformance Certification of the AN/PSC-5C Shadowfire Manpack Radio.

2. PROPONENT. Tactical Radio Communications Systems
Building 456
Fort Monmouth, NJ 07703-5000

3. PROGRAM MANAGER/USER POC. Mr. Paul Hancik, (732) 532-7300
E-mail: paul.hancik@c3smail.monmouth.army.mil

4. TESTERS. Joint Interoperability Test Command (JITC):
Mr. Larry Metz, (520) 538-5215
Mr. Dan Bear, (520) 538-4214
Ms. Norma Vega, (520) 538-1741

5. SYSTEM DESCRIPTION. The AN/PSC-5C Shadowfire Manpack Terminal is an Ultra High Frequency (UHF) Satellite Communications (SATCOM) terminal capable of both dedicated and Demand Assigned Multiple Access (DAMA) modes of operation. The terminal provides internal Transmission Security (TRANSEC) for orderwire encryption in the DAMA mode, and embedded Communications Security (COMSEC) for user communications encryption in all modes. Engineering Change Proposal (ECP) 32 is a hardware and software modification to the AN/PSC-5 Spitfire Manpack Radio designed to provide a field upgrade resulting in the AN/PSC-5C Shadowfire Manpack Radio. ECP 32 uses a module replacement that provides additional data rates for MIL-STD-188-181B and Mixed Excitation Linear Prediction (MELP) techniques. In addition, the upgrade includes improved narrowband voice vocoder, embedded Automatic Data Controller, embedded Internet Protocol layer, and numerous other enhancements. The additional enhancements include HAVE QUICK and SINCGARS frequency hopping, the addition of higher data rates in Line-of-Sight mode, and operator menu enhancements.

6. TEST NETWORK DESCRIPTION. The test networks varied for each MIL-STD requirement being verified. Testers used various terminal configurations with commercial-off-the-shelf test equipment to verify each MIL-STD requirement. Detailed test configurations and data collection information are in the appropriate sections of the JITC test procedure, “MIL-STD-188-181/MIL-STD-188-181A/MIL-STD-188-181B Conformance Test Procedure,” May 2001. Figure 1 shows the system configuration of the tested terminal.

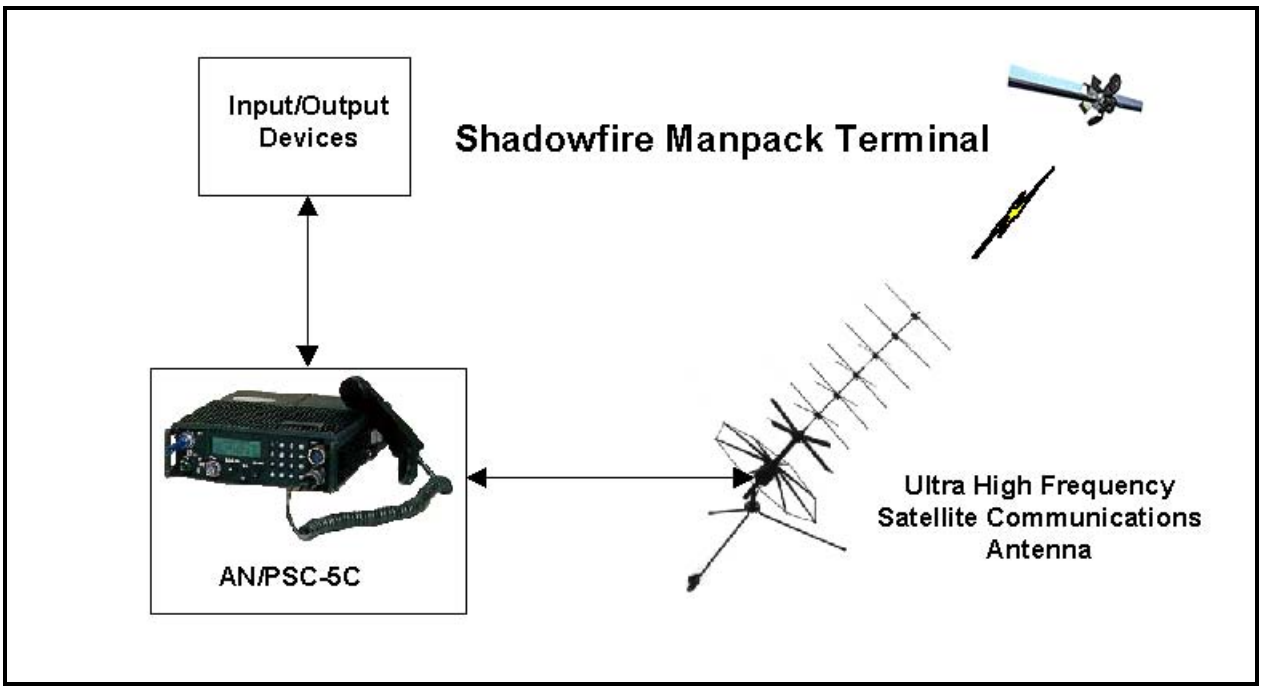

Figure 1. System Configuration

7. SYSTEM CONFIGURATION. Terminal components and software versions include:

AN/PSC-5C Shadowfire ..... RT-1672C(C)/U
Control Processor Software (CP-SW)..... CTRL 02.78
Control Processor Hardware (CP-VHDL)..... CPHW 02.10
Modem Orderwire Encryption Board (Modem OEB)..... MOEB 02.00
Modem Digital Signal Processor (Modem DSP) ..... MDSP 05.19
Modem..... Version 14.00
Shadowfire Baseband Processor Software (BP-SFIRE)..... BPSW 08.13
SINCGARS Baseband Processor Software (BP-SGARS)..... BPSW 08.13
Baseband Processor Hardware (BP-VHDL) BPHW 02.40
Baseband Processor Hardware (BP-HW)..... *BPHW xx.xx
Fill Processor Software (FP-SW)..... FPSW 05.05
Fill Processor Hardware (FP-VHDL)..... FPHW 02.40
ANDVT Processor Software (AP-SW) ..... APSW 08.19
ANDVT Processor Hardware (AP-VHDL) ..... APHW 06.90
ANDVT Processor Hardware (AP-HW)..... *APHW xx.xx
TCP/IP Processor Software (TP-SW)..... TPSW 06.07

* - Raytheon hardware manufacturing uses these version numbers to track revisions on manufacturing parts lists. These version numbers will vary in fielded radios and have no effect on the installed software.

8. MODES OF OPERATION. All MIL-STD-188-181B mandatory and implemented optional data rates and capabilities have been verified. Optional data rates and modulation capabilities implemented in this terminal are contained in tables 1 and 2. The terminal only provides half-duplex operation. Optional MELP techniques for narrowband secure voice communications are implemented in this terminal.

9. TESTING LIMITATIONS. None.

10. REQUIRED STANDARDS AND CONFORMANCE. The required standard is MIL-STD-188-181B, "Interoperability Standard for Single-Access 5-kHz and 25-kHz UHF Satellite Communications Channels," 16 October 2001. Table 3 delineates all the MIL-STD requirements and indicates the status as "Met," "Not Met," "Not Tested," or "Not Applicable." The AN/PSC-5C Shadowfire Manpack Terminal meets the mandatory requirements set forth in MIL-STD-188-181B. The following provides details and impacts to some of the noted requirements.

a. Requirement 5, paragraph 4.2.3, "Hardware implementation of the terminals with imbedded COMSEC shall include provisions for future implementation of Over-the-Air Rekeying (OTAR)."

(1) Met with Comment. OTAR was successfully demonstrated in this terminal with the Uncooperative Automatic Key (AK) function using the VINSON COMSEC waveform, the Advanced Narrowband Digital Voice Terminal (ANDVT) COMSEC waveform, and the MELP narrowband secure voice modes of operation. Uncooperative AK was successfully demonstrated using the TSEC/KG-84A COMSEC waveform mode of operation up to, and including, data rates of 16 kilobits per second (kbps). The Cooperative Manual Key (MK) function was successfully demonstrated using the VINSON COMSEC waveform, the ANDVT COMSEC waveform, and the MELP narrowband secure voice modes of operation. The Variable Update (VU) OTAR function was also successfully demonstrated.

(2) Impact. None. The terminal demonstrated provisions for future implementation of OTAR.

b. Requirement 15, paragraph 5.1.1.4.2(1), "For carrier EIRP levels equal to or greater than +18 dBW, the maximum EIRP values shall not exceed the values specified table II [of the MIL-STD]."

(1) Met with Comment. As tested, the maximum Effective Isotropically Radiated Power (EIRP) levels allowed, including cable loss and antenna gain, to meet the high-power Adjacent Channel Emission (ACE) requirement are specified in table 1 for all narrowband data rates tested.

Table 1. Narrowband EIRP

INPUT/OUTPUT DATA RATE (bps)	MODULATION TYPE	CODING TYPE	MAXIMUM EIRP (dBWi)
1200	SBPSK	None	21.8
2400	SBPSK	None	18.9
4800	CPM	None	20.4
*7200	CPM	None	22.0
*8000	CPM	None	22.2
9600	CPM	None	20.1

*Optional Data Rate
bps = bits per second
CPM = Continuous Phase Modulation
dBWi = decibels referenced to 1 watt, relative to isotropically radiated power
SBPSK = Shaped Binary Phase-Shift Keying

(2) Impact. Minor. If the terminal is operated at EIRP levels greater than those specified in the table, ACE will potentially cause friendly jamming and transmission disruption in adjacent channels. The maximum EIRP levels specified, including cable loss and antenna gain, are normally more than enough power to maintain adequate link quality.

c. Requirement 101, paragraph 5.2.1.4(2), "For modulations other than FSK at 16000 bps, in a nominal 25-kHz bandwidth whose center frequency is displaced Δf from the terminal transmitter's carrier frequency, the EIRP shall not exceed the values specified in table VIIa [of the MIL-STD] for a carrier level less than +18 dBW and table VIIb [of the MIL-STD] for a carrier level greater than or equal to +18 dBW."

(1) Met with Comment. As tested, the maximum EIRP levels allowed, including cable loss and antenna gain, to meet the high-power ACE requirement are specified in table 2 for all wideband data rates tested.

Table 2. Wideband EIRP

INPUT/OUTPUT DATA RATE (bps)	MODULATION TYPE	CODING TYPE	MAXIMUM EIRP (dBWi)
*9600	SBPSK	None	19.3
19200	CPM	None	33.2
*28800	CPM	None	34.0
32000	CPM	None	32.9
38400	CPM	None	31.0
48000	CPM	None	29.3

*Optional Data Rate
bps = bits per second
CPM = Continuous Phase Modulation
dBWi = decibel (dB) referenced to 1 watt, relative to isotropically radiated power
SBPSK = Shaped Binary Phase-Shift Keying

(2) Impact. Minor. If the terminal is operated at EIRP levels greater than those specified in the table, ACE will potentially cause friendly jamming and transmission disruption in adjacent channels. The maximum EIRP levels specified, including cable loss and antenna gain, are normally more than enough power to maintain adequate link quality.

11. TEST AND ANALYSIS REPORT. JITC distributes test documentation via the JITC Electronic Report Distribution system which uses unclassified (NIPRNET) e-mail. More comprehensive information is available via the JITC System Tracking Program (STP). The STP is accessible by .mil/.gov users on the NIPRNET at https://stp.fhu.disa.mil. Test reports, lessons learned, and related testing documents and references are on the JITC Joint Interoperability Tool (JIT) at http://jit.fhu.disa.mil (NIPRNET) or http://199.208.204.125 (SIPRNET). JITC also provides a DAMA Certification Register on the JITC public website under "Product Registers." The DAMA Certification Register can be reached directly at http://jitc.fhu.disa.mil/reg/dama1.html. The UHF SATCOM DAMA Test Facility homepage can be reached directly at http://jitc.fhu.disa.mil/reg/uhfdama.htm. The testing agent point of contact is Norma Vega, DSN 879-1741, Commercial (520) 538-1741, e-mail vegan@fhu.disa.mil.

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Table 3. MIL-STD-188-181B Requirements Matrix for the AN/PSC-5C Shadowfire Manpack Terminal

JITC REQ #	MIL-STD Paragraph	REQUIREMENT DESCRIPTION	STATUS
1	4.1(1)	Optional capabilities that are implemented **shall** be as specified in this standard.	**Met**
2	4.1(2)	Interoperable access modes **shall** be single access on a satellite channel.	**Met**
3	4.2.2(1)	For coherent demodulation (PSK or CPM), the terminal **shall** transmit a preamble (see 5.1.4.1 and 5.2.4.1) to allow demodulator synchronization before the communications security (COMSEC) synchronization preamble is transmitted.	**Met**
4	4.2.2(2)	A preamble **shall** not be used for FSK modulation in the wideband mode.	**Met**
5	4.2.3	Hardware implementation of the terminals with imbedded COMSEC **shall** include provisions for future implementation of Over-the-Air Rekeying (OTAR).	**Met (Note)**
Note: Over-the-Air Rekeying (OTAR) functions demonstrated with this terminal are described in the Conformance Testing Summary.			
6	4.2.4	The waveform **shall** interface with Fleet Satellite Communications (FLTSATCOM) and UHF Follow-On (UFO) satellites.	**Met**
7	4.2.5	If the terminal implements FEC, it **shall** be compliant with the FEC requirements of this standard.	**Not Applicable (Note)**
Note: Optional requirement not implemented in this terminal.			
8	5.1.1.1(1)	The terminal **shall** be capable of providing EIRP of at least 16 dBW with respect to right-hand circular polarization.	**Met**
9	5.1.1.1(2)	The terminal eirp **shall** be incrementally or continuously adjustable between a minimum setting no greater than 10 dBW and the maximum eirp, with a power setting resolution of 2 dB or better.	**Met**
10	5.1.1.2	The terminal **shall** maintain eirp accuracy of ±1.5 dB, assuming antenna gain and passive losses are fixed.	**Met**
11a	5.1.1.3(1)	Transmitter turn-on time requirement is dependent upon whether operating in non-TDMA or TDMA mode as follows: (a) When performing non-TDMA transmissions, the transmitter turn-on time **shall** not exceed 50 ms. The transmitter turn-on time will be measured only for table III options that do not include Reed-Solomon coding due to interleaver-block delays introduced by the interleaving used with Reed-Solomon coding.	**Met**
11b	5.1.1.3(2)	(b) When transmitting within a time slot (TDMA operation), the transmitter turn-on time **shall** not exceed 875 microseconds (μs).	**Met (Note)**
Note: This requirement was met during MIL-STD-188-183 certification testing.			
12	5.1.1.4	In a nominal 5-kHz bandwidth whose center frequency is displaced by Δf from a terminal transmitter's carrier frequency, the eirp **shall** be as specified in 5.1.1.4.1 and 5.1.1.4.2.	**Met**
13	5.1.1.4.1(1)	The eirp, relative to the transmitter's total output eirp, **shall** not exceed the values specified in table II [of the MIL-STD].	**Met**
14	5.1.1.4.1(2)	These values **shall** apply when the transmitter carrier frequency is either unmodulated or modulated.	**Met**
15	5.1.1.4.2(1)	For carrier eirp levels equal to or greater than +18 dBW, the maximum eirp values **shall** not exceed the values specified as "maximum eirp" in table II [of the MIL-STD].	**Met (Note)**
Note: The maximum terminal eirp levels to meet this requirement are listed in table 1 of the Conformance Certification Testing Summary.			
16	5.1.1.4.2(2)	These values **shall** apply when the transmitter carrier frequency is either modulated or unmodulated.	**Met**

JITC REQ #	MIL-STD Paragraph	REQUIREMENT DESCRIPTION	STATUS
17	5.1.1.5	The transmit frequency **shall** be tunable in 5-kHz increments over the frequency range of 291.000 to 318.300 MHz.	**Met**
18	5.1.1.6(1)	The phase noise power spectral density at 10 Hz offset from the carrier **shall** not exceed -46 dBc/Hz.	**Met**
19	5.1.1.6(2)	The single side-band root-mean-square value of the phase noise **shall** not exceed 2.5 degrees over the bandwidth of 10 Hz to 100 kHz.	**Met**
20	5.1.2.1a	The terminal **shall** achieve a bit error ratio (BER) of $1x10^{-5}$ or better at the C/kT specified in table III [of the MIL-STD], when it receives a bandlimited and hardlimited downlink desired signal having the characteristics of a representative 5-kHz UHF SATCOM transponder.	**Met**
21	5.1.2.1b	The BER performance **shall** not be degraded by more than 1 dB from the numbers in table III [of the MIL-STD] in the presence of ACI that is: (1) 15 dB or more below the average power of the desired PSK signal. (2) 20 dB or more below the average power of the desired CPM signal.	**Met**
22	5.1.2.2	The receive frequency **shall** be tunable in 5-kHz increments over a frequency range of 243.000 to 270.000 MHz.	**Met**
23	5.1.2.3	The G/T performance of the terminals, assuming a sky noise temperature of 290 K, **shall** be equal to or greater than the values shown in table IV [of the MIL-STD].	**Not Testable (Note)**
Note: This requirement is not directly testable.			
24	5.1.3	Modulation **shall** be as shown in table III [of the MIL-STD].	**Met**
25	5.1.3.1(1)	The phase vector rotation caused by modulation **shall** not cause a frequency shift in the transmitted data.	**Met**
26	5.1.3.1(2)	The modulation for OQPSK/SOQPSK, if implemented, **shall** be interoperable with the SOQPSK signal described below, where the shaping factor α can be any value between 0 and 0.5, provided that requirements for adjacent channel emissions are met.	**Not Applicable (Note)**
Note: Optional requirement not implemented in this terminal.			
27	5.1.3.2	The multi-*h* CPM modulation signal **shall** be interoperable with the CPM waveform that is generated in accordance with appendix E [of the MIL-STD].	**Met**
28	5.1.4.1	The transmitting radio **shall** generate a preamble as specified by 5.1.4.1.1 and 5.1.4.1.2.	**Met**
29	5.1.4.1.1(1)	The preamble **shall** be as specified on figure 2A [of the MIL-STD] for BPSK/ SBPSK and figure 2B [of the MIL-STD] for OQPSK/SOQPSK, if applicable.	**Met**
30	5.1.4.1.1(2)	Baseband data **shall** follow the preamble bit pattern without a shift in data bit timing greater than 25 percent of a bit interval.	**Met**
31	5.1.4.1.2(1)	The CPM preamble **shall** be as shown on figure 2C [of the MIL-STD], and as specified in 5.1.4.1.2.1 to 5.1.4.1.2.3.	**Met**
32	5.1.4.1.2(2)	The preamble **shall** be binary single-*h* CPM [8/16] (equivalent to MSK) modulated and transmitted at the symbol rate.	**Met**
33	5.1.4.1.2.3(1)	The first fill bit **shall** be determined such that there is even parity (even number of 1s) on the entire header field.	**Met**
34	5.1.4.1.2.3(2)	The following five fill bits **shall** be all zeros.	**Met**
35	5.1.4.1.2.4(1)	Data traffic **shall** be transmitted immediately following the preamble without a shift in timing and at the same symbol rate as the preamble.	**Met**
36	5.1.4.1.2.4(2)	The data traffic **shall** be modulated, coded, and interleaved, as specified in the header.	**Met**
37	5.1.4.2(1)	For CPM, the receiver **shall** determine data rate, modulation parameters, coding, and interleaving from the preamble.	**Met**

JITC REQ #	MIL-STD Paragraph	REQUIREMENT DESCRIPTION	STATUS
38	5.1.4.2(2)	For uncoded PSK, the terminal **shall** output, as a minimum, all baseband data that immediately follows the preamble bit pattern.	**Met**
39	5.1.4.2(3)	For coded PSK and all CPM waveforms, the terminal **shall** output only the baseband data that immediately follows the preamble bit pattern.	**Met**
40	5.1.4.3	The terminal **shall** achieve acquisition and demodulate the signal for carrier frequency uncertainties up to ±1.2 kHz at the receive antenna.	**Met**
41	5.1.4.4	The probability of achieving acquisition on the first attempt under the conditions described in 5.1.4.3 and E_b/N_o equal to or higher than the reference E_b/N_o **shall** exceed 95% with a confidence level of 90%.	**Met**
42	5.1.4.5(1)	The probability of maintaining bit synchronization for at least 10 seconds, when the *C/kT* is degraded by up to 3 dB from that which is specified in 5.1.2.1, **shall** be 95 percent with a confidence level of 90 percent.	**Met**
43	5.1.4.5(2)	The terminal **shall** maintain bit synchronization if the carrier is lost and returns within 230 milliseconds (ms).	**Met**
44	5.1.4.5(3)	The terminal **shall** synchronize to and process a new carrier if the original carrier is lost and does not return and the new carrier is detected within a time that is based on the baseband data rate as follows: a. For baseband data rates ≥1200 bps, within 250-ms of the time of loss of the original carrier. b. For baseband data rates <1200 bps within 550-ms of the time of loss of the original carrier.	**Met**
45	5.1.4.6	The terminal **shall** maintain the frequency of its receive clock output to data terminal equipment within ±1 percent of the clock frequency for the selected operating data rate under all conditions where bit synchronization can be maintained.	**Met**
46	5.1.5	The frequency generation system **shall** provide long-term plus short-term frequency accuracy within ±1 part per million (ppm) across the full range of environmental conditions outlined in the terminal specification.	**Met**
47	5.1.6(1)	For 2400 bps voice, the voice digitization **shall** be interoperable with equipment that meets the requirements of Standardization Agreement (STANAG) 4198.	**Met**
48	5.1.6(2)	It **shall** be interoperable with the CV-3591.	**Met**
49	5.1.6(3)	If 4800 bps voice is implemented, the voice digitizer **shall** comply with requirements of FED-STD-1016.	**Not Applicable (Note)**
Note: Optional requirement not implemented in this terminal.			
50	5.1.7.1a	[Voice] The COMSEC waveform **shall** be interoperable with the AN/USC-43 (ANDVT) waveform, used in application 3, as specified in MIL-C-28883, when transmitting and receiving.	**Met**
51	5.1.7.1b	[Voice] Secure voice at 4800 bps **shall** be interoperable with the digitization techniques specified in FED-STD-1016, and the encryption techniques used by the TSEC/KG-84A/C, as specified in NSA NO. 82-2.	**Not Applicable (Note)**
Note: Optional requirement not implemented in this terminal.			
52	5.1.7.2a	[Data] The COMSEC waveforms **shall** be interoperable with the AN/USC-43 (ANDVT) waveform used in application 3, as specified in MIL-C-28883, when transmitting and receiving.	**Met**
53	5.1.7.2b	[Data] The COMSEC waveforms **shall** be interoperable with the TSEC/KG-84A/C when transmitting and receiving as specified in NSA NO 82-2.	**Met**

JITC REQ #	MIL-STD Paragraph	REQUIREMENT DESCRIPTION	STATUS
54	5.1.8(1)	All baseband data following the preamble bit pattern **shall** be differentially encoded for BPSK/SBPSK and OQPSK/ SOQPSK modulation.	**Met**
55	5.1.8(2)	For BPSK/SBPSK with or without FEC, and for OQPSK/SOQPSK with FEC, the differential encoding **shall** be as follows: [defined in paragraph 5.1.8 of the MIL-STD].	**Met**
56	5.1.8(3)	For OQPSK/SOQPSK without FEC the differential coding **shall** be as follows: [defined in paragraph 5.1.8 of the MIL-STD].	**Not Applicable (Note)**
57	5.1.8(4)	When optional FEC is used with PSK modulation, the differential encoding **shall** precede the FEC in the processing of data to be transmitted.	
58	5.1.9.1(1)	If FEC coding is implemented, the terminal **shall** add a Start-0f-Message (SOM) data field to the preamble shown in figures 2A or 2B [of the MIL-STD] preceding the baseband transmission.	
59	5.1.9.1(2)	For BPSK/SBPSK, the SOM **shall** be the 37-bit sequence, 1110001000011000111101001101110110010 1.	
60	5.1.9.1(3)	For OQPSK/SOQPSK, the 42-bit SOM **shall** be a 21-bit sequence in each I and Q channel, where the I channel sequence is 000000101110100111001 and the Q channel sequence, offset one-half symbol later, is 001101100001000010101.	
61	5.1.9.1(4)	The SOM **shall** be transmitted in the order shown with the left-most bit transmitted first.	
62	5.1.9.1(5)	For OQPSK/SOQPSK modulation with FEC coding, the first FEC-encoded user data bit **shall** be sent on the I channel.	
63	5.1.9.1(6)	The output of the FEC encoder **shall** be identical to the output of the rate 1/2 constraint length 7 convolutional encoder shown on figure 5 [of the MIL-STD].	
64	5.1.9.1(7)	For rate 3/4 the output of the encoder **shall** be identical with the output described in 5.1.9.1.2.	
65	5.1.9.1.1	The encoder tap connections **shall** be as shown in figure 5 [of the MIL-STD].	
66	5.1.9.2(1)	If FEC is implemented [for CPM] it **shall** be a Reed Solomon (RS) code that is derived from a (63,k) RS code.	
67	5.1.9.2(2)	The codes used **shall** be as defined in table III [of the MIL-STD] and...	
68	5.1.9.2(3)	...**shall** be derived in accordance with 5.1.9.2.1.	
69	5.1.9.2.1	The field generator polynomial **shall** be, $p(x)=x^6 + x + 1$ (Data Encoding)	
Note: Optional requirements not implemented in this terminal.			
70	5.1.10	The terminal **shall** comply with the BER requirements of 5.1.2.1a, under the Doppler rate of change conditions defined below, with no more than an additional 1 dB degradation allowed to the *C/kT* numbers in table III [of the MIL-STD]. a. 32 Hz per second, for modulation rates ≥600 sps, and b. 5 Hz per second, for modulation rates <600 sps.	**Met**
71	5.1.11	To enable quick end-of-burst detection, an End of Message (EOM) bit sequence **shall** be used for all CPM and FEC coded PSK waveforms.	**Met**
72	5.1.11.1(1)	For FEC-encoded PSK the end of message bit sequence **shall** be encoded in the same manner as the information bit stream.	**Not Applicable (Note)**
73	5.1.11.1(2)	The information bit stream **shall** be appended with *N* zero bits.	
Note: Optional requirements not implemented in this terminal.			

JITC REQ #	MIL-STD Paragraph	REQUIREMENT DESCRIPTION	STATUS
74	5.1.11.1(3)	The value of *N* **shall** be between 0 and 47 and...	**Not Applicable (Note)**
75	5.1.11.1(4)	...**shall** be selected such that the total number of information bits (input bits + appended zero bits) is divisible by 48 without a remainder.	
76	5.1.11.1(5)	The preamble or SOM bits **shall** not be counted as part of the input bits.	
77	5.1.11.1(6)	The EOM sequence **shall** follow the appended zeros.	
78	5.1.11.1(7)	The EOM sequence **shall** be a 144-bit sequence defined by repetition of the 48-bit sequence equivalent to hexadecimal F740 141F EC1B transmitted three times.	
79	5.1.11.1 (8)	The left-most hexadecimal digit shall be transmitted first.	
80	5.1.11.1(9)	After the EOM sequence is transmitted, the transmitter **shall** be disabled.	
Note: Optional requirements not implemented in this terminal.			
81	5.1.11.2(1)	For uncoded CPM the end of message bit sequence **shall** be modulated in the same manner as the information bit stream.	**Met**
82	5.1.11.2(2)	The information bit stream **shall** be appended with *N* bits of the pattern 1100.	**Met**
83	5.1.11.2(3)	The value of *N* **shall** be between 0 and 47 and...	**Met**
84	5.1.11.2(4)	...**shall** be selected such that the total number of information bits (input bits + appended bits is divisible by 48 without a remainder.	**Met**
85	5.1.11.2(5)	The preamble, SOM, and header bits **shall** not be counted as part of the input bits.	**Met**
86	5.1.11.2(6)	The EOM sequence **shall** follow the appended bits.	**Met**
87	5.1.11.2(7)	The EOM sequence **shall** be a 144-bit sequence defined by repetition of the 48-bit sequence equivalent to hexadecimal F740 141F EC1B transmitted three times.	**Met**
88	5.1.11.2(8)	The left-most hexadecimal digit **shall** be transmitted first.	**Met**
89	5.1.11.2(9)	After the EOM sequence is transmitted, the transmitter **shall** be disabled.	**Met**
90	5.1.11.3(1)	For coded CPM the end of message bit sequence **shall** be generated and transmitted without FEC encoding.	**Not Applicable (Note)**
91	5.1.11.3(2)	The information bit stream **shall** be appended with a sufficient number of bits of pattern 1100 which, when encoded, will fill the last interleaver block.	
92	5.1.11.3(3)	The EOM sequence **shall** follow the last interleaver block.	
Note: Optional requirements not implemented in this terminal.			

93	5.1.11.3(4)	The EOM sequence **shall** be a 144-bit sequence defined by repetition of the 48-bit sequence equivalent to hexadecimal F740 141F EC1B transmitted three times.	**Not Applicable (Note**
94	5.1.11.3(5)	The left-most hexadecimal digit **shall** be transmitted first.	
95	5.1.11.3(6)	After the EOM sequence is transmitted, the transmitter **shall** be disabled.	
Note: Optional requirements not implemented in this terminal.			
96	5.2.1.1(1)	The terminal **shall** be capable of providing eirp of at least 16 dBW with respect to right-hand circular polarization.	**Met**
97	5.2.1.1(2)	The terminal eirp **shall** be incrementally or continuously adjustable between a minimum setting no greater than 10 dBW and the maximum eirp, with a power setting resolution of 2 dB or better.	**Met**
98	5.2.1.2	The terminal **shall** maintain an eirp accuracy of ±1.5 dB, assuming antenna gain and passive losses are fixed.	**Met**

99a	5.2.1.3(1)	When performing non-TDMA transmissions, the transmitter turn-on time **shall** not exceed 50 ms. The transmitter turn-on time will be measured only for table VIII [of the MIL-STD] options that do not include Reed-Solomon coding due to interleaver-block delays introduced by the interleaving used with Reed-Solomon coding.	**Met**
99b	5.2.1.3(2)	When transmitting within a time slot (TDMA operation), the transmitter turn-on time **shall** not exceed 875 microseconds (μs).	**Met (Note)**
Note: This requirement was met during MIL-STD-188-183 certification testing.			
100	5.2.1.4(1)	For FSK modulation, the total of all emissions outside to the 3 dB bandwidth of the 25-kHz channel (i.e., 30kHz) **shall** be less than 1 percent of the total transmitted power.	**Met**
101	5.2.1.4(2)	For modulations other than FSK at 16000 bps, in a nominal 25-kHz bandwidth whose center frequency is displaced by Δf from the terminal transmitter's carrier frequency, the eirp **shall** not exceed the values specified in table VIIa [of the MIL-STD] for a carrier level less than +18 dBW and table VIIb [of the MIL-STD] for a carrier level greater than or equal to +18 dBW.	**Met (Note)**
Note: The maximum terminal eirp levels to meet this requirement are listed in table 2 of the Conformance Certification Testing Summary.			
102	5.2.1.5	Transmit frequency **shall** be tunable in 25-kHz increments over a frequency range of 291.000 to 318.300 MHz.	**Met**
103	5.2.1.6	Phase noise **shall** be as specified in 5.1.1.6.	**Met**
104	5.2.2.1a	The terminal **shall** achieve a bit error ratio (BER) of 1 x 10-5 or better at the *C*/*kT* specified in table VIII [of the MIL-STD], when it receives a bandlimited and hardlimited downlink desired signal having the characteristics of a representative 25-kHz UHF SATCOM transponder.	**Met**
105	5.2.2.1b	The BER performance **shall** not be degraded by more than 1 dB from the numbers in table VIII [of the MIL-STD] in the presence of adjacent channel interference that is: (1) 15 dB or more below the average power of the desired PSK signal, and (2) 20 dB or more below the average power of the desired CPM signal.	**Met**
106	5.2.2.2	The receive frequency **shall** be tunable in 25-kHz increments over a frequency range of 243.000 to 270.000 MHz.	**Met**
107	5.2.3	Modulation **shall** be as shown in table VIII [of the MIL-STD], and as specified in 5.2.3.1 and 5.2.3.4.	**Met**

108	5.2.3.1	The FSK modulation characteristics **shall** be specified in 5.2.3.1.1 and 5.2.3.1.2.	**Met**
109	5.2.3.1.1(1)	The deviation of the modulated signal **shall** be 5.6 kHz ±1 kHz for a binary 0 and -5.6 kHz ±1 kHz for a binary 1.	**Met**
110	5.2.3.1.1(2)	The demodulator **shall** be interoperable with modulated signals that have deviations of 5.6 kHz ±1.2 kHz for a binary 0 and -5.6 ±1.2 kHz for a binary 1.	**Met**
111	5.2.3.1.2	A binary 1 **shall** be indicated by a voltage that is negative with respect to the reference point, and a binary 0 by a voltage that is positive with respect to the reference point.	**Met**
112	5.2.3.2	The phase vector rotation caused by modulation **shall** not cause a frequency shift in the transmitted data.	**Met**
113	5.2.3.3	OQPSK and SOQPSK modulation **shall** be as defined in 5.1.3.1.	**Not Applicable (Note)**
Note: Optional requirement not implemented in this terminal.			

114	5.2.3.4	The multi-*h* CPM modulation signal **shall** be interoperable with the CPM waveform that is generated in accordance with appendix E [of the MIL-STD].	**Met**
115	5.2.4.1	The transmitting radio **shall** generate a preamble as specified in 5.1.4.1.	**Met**
116	5.2.4.2	The requirements stated in 5.1.4.2 **shall** apply.	**Met**
117	5.2.4.3	The terminal **shall** achieve acquisition and demodulate the signal for carrier frequency uncertainties up to ±1.2 kHz from the desired channel center frequency.	**Met**
118	5.2.4.4	The probability of achieving acquisition on the first attempt under the conditions of 5.2.4.3 and *Eb/N0* equal to or higher than the reference *Eb*/*N0* **shall** exceed 95 percent, with a confidence level of 90 percent.	**Met**
119	5.2.4.5(1)	The probability of maintaining bit synchronization for at least 10 seconds when the *C*/*kT* is degraded by up to 3 dB from that which is specified in 5.2.2.1, **shall** be 95 percent with a confidence level of 90 percent.	**Met**
120	5.2.4.5(2)	For PSK or CPM signals, the terminal **shall** maintain bit synchronization if the carrier is lost for up to 230 ms.	**Met**
121	5.2.4.5(3)	For any signal (PSK, CPM, or FSK), the terminal **shall** synchronize to and process a new carrier if the original carrier is lost and does not return and a new carrier is detected within 250 ms of the time of loss of original carrier signal.	**Met**
122	5.2.4.6	The terminal **shall** maintain the frequency of its receive clock output to data terminal equipment within ±1 percent of the clock frequency for the selected operating data rate, under all conditions where bit synchronization can be maintained.	**Met**
123	5.2.5	The frequency generation system **shall** provide long-term plus short-term frequency accuracy within ±1.0 ppm across the full range of environmental conditions outlined in the terminal specification.	**Met**
124	5.2.6	Secure voice at 16 kbps **shall** be interoperable with continuously variable slope delta (CVSD) digitization techniques used by the VINSON encryption device, as specified in NSA NO. CSESD-14.	**Met**
125	5.2.7	The COMSEC device **shall** be interoperable with the TSEC/KY-57 and TSEC/KY-58.	**Met**
126	5.2.7.1	Secure voice at 16 kbps **shall** be interoperable with techniques used by the VINSON, as specified in NSA NO. CSESD-14.	**Met**
127	5.2.7.2a	Mandatory: The COMSEC waveforms **shall** be interoperable with the TSEC/KY-57/58 VINSON waveform when transmitting and receiving, as specified in NSA NO. CSESD-14.	**Met**
128	5.2.7.2b	Optional. The COMSEC waveforms **shall** be interoperable with the TSEC/KG-84A/C waveform when transmitting and receiving, as specified in NSA NO. 82-2.	**Met**
129	5.2.8	For PSK modulation at all bit rates, all baseband data following the preamble bit pattern **shall** be differentially encoded as specified in 5.1.8.	**Met**
130	5.2.9	FEC coding, if implemented, **shall** be as defined in 5.1.9.	**Not Applicable (Note)**
131	5.2.9.1(1)	If FEC is implemented, it **shall** be a Reed Solomon (RS) code that is derived from a (127,k) RS code.	
132	5.2.9.1(2)	The codes used **shall** be as defined in table VIII [of the MIL-STD], and...	
133	5.2.9.1(3)	...**shall** be derived in accordance with 5.1.9.1.1.	
134	5.2.9.1.1	The field generator polynomial **shall** be, $p(x) = x^7 + x^3 + 1$ (Data Encoding)	
135	5.2.9.2	Interleaving **shall** be as defined in 5.1.9.2.4, except that there are seven bits per symbol.	
Note: Optional requirements not implemented in this terminal.			

136	5.2.10	In the presence of a Doppler rate of change of 32 Hz per second, the BER requirements of 5.2.2.1a **shall** be met with an additional 1 dB allowed to the *C/kT* numbers in table VIII [of the MIL-STD].	**Met**
137	5.2.11	Postamble **shall** be as defined in 5.1.11.	**Met**
138	E.3.1	The terminal **shall** be interoperable with the specific quaternary full-response multi-*h* CPM waveform described below.	**Met**
139	E.3.3(1)	The first data symbol is transmitted immediately after the preamble and **shall** use the h_1 modulation index.	**Met**
140	E.3.3(2)	The next data symbol **shall** use the h_2 modulation index.	**Met**
141	E.3.3(3)	Subsequent data symbols **shall** alternate modulation indices {$h_1, h_2, h_1, h_2...$}.	**Met**
142	E.3.4(1)	The demodulator **shall** use the 192 symbols of preamble pattern shown on figure 2C [of the MIL-STD] in order to synchronize to the amplitude, phase and timing of the incoming data burst.	**Met**
143	E.3.4(2)	The Frame timing and modulation parameters **shall** be determined by correctly demodulating the start of message and header of the preamble.	**Met**
144	E.3.4(3)	Immediately following the six fill bits of the preamble sequence, data and clock **shall** be sent to the baseband interface.	**Met**
145	E.3.4(4)	The first data symbol **shall** be received immediately after the preamble and...	**Met**
146	E.3.4(5)	...**shall** use the h_1 modulation index.	**Met**
147	E.3.4(6)	The next data symbol **shall** use the h_2 modulation index.	**Met**
148	E.3.4(7)	Subsequent data symbols **shall** alternate modulation indices {$h_1, h_2, h_1, h_2...$}.	**Met**